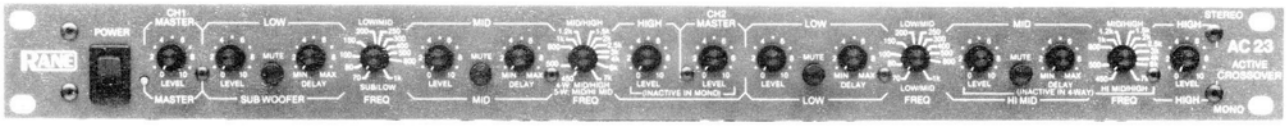
10/88

AC 22 and AC 23

ACTIVE CROSSOVERS



OPERATING

AND

SERVICE

MANUAL

RANE
CORPORATION

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I. WARRANTY EXPLANATION - PLEASE READ CAREFULLY

Rane offers a limited warranty, described in full on the Limited Warranty card included in the packing materials, which covers both parts and labor necessary to repair any defects in the manufacturing of you Rane product.

The warranty period is two (2) years, starting from either (i) the date of retail purchase, as noted on either the sales slip from an authorized Rane dealer or on the warranty registration card sent in to the factory or, (ii) in the event no proof of purchase date is available, from the date of manufacture, which is coded on the rear of the chassis.

If you send in the registration card according to the instructions on the card, or retain your sales slip as proof of purchase, you will receive a full two (2) year warranty period from the date of **purchase**, regardless of the date of manufacture. If you do not send in the registration card ("I forgot."), or you do not have a sales slip from an authorized Rane dealer ("My dog ate it."), the warranty period will only extend two (2) years from the date of **manufacture**.

All registered warranties are tracked by serial number, not by owner. Once your Rane product is registered, it will be covered the full two years, regardless of any change in ownership.

Should you encounter any problems with your Rane product, be sure to contact either your local Rane dealer or the Rane factory before taking it anywhere for repairs. We will help you to identify and locate any specific malfunctions, possibly avoid needless shipment, or instruct you as to the speediest method for authorized repair.

If you must send your Rane product to the factory or a warranty station for repair, BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

1. YOUR COMPLETE NAME AND RETURN SHIPPING ADDRESS (P.O. box numbers are NOT acceptable)
2. THE SERIAL NUMBER OF THE RANE PRODUCT IN FOR REPAIR
3. A COMPLETE DESCRIPTION OF ANY AND ALL PROBLEMS YOU ARE EXPERIENCING WITH THE PRODUCT.

Never ship the unit in any shipping carton other than the original or a replacement supplied by Rane. Ship only by a reputable carrier. Be sure to insure the package for the full replacement value. Rane cannot be held responsible for any damage incurred during shipping.

NOTICE REGARDING DAMAGES

THE RANE LIMITED WARRANTY COVERS ONLY THE COSTS IN LABOR AND MATERIALS TO REPAIR DEFECTS IN MATERIAL OR WORKMANSHIP OR, AT RANE'S OPTION, TO REPLACE DEFECTIVE PRODUCTS. CONSEQUENTIAL AND INCIDENTAL DAMAGES SUCH AS ECONOMIC LOSS OR INJURY TO PERSON OR PROPERTY, WHATEVER THE CAUSE, ARE EXCLUDED FROM COVERAGE. PLEASE REFER TO THE LIMITED WARRANTY CARD FOR A FULL DESCRIPTION OF THE LIMITS ON THE COVERAGE OF THE LIMITED WARRANTY.

If you need further assistance concerning the repair, installation or operation of your Rane product, please feel free to contact Rane galactic headquarters at:

Rane Corporation
10802 47th Avenue West
Everett, WA 98204-3400
Phone: (206) 355-6000
FAX: (206) 347-7757

THESE ARE AUTOMATIC CROSSOVERS!

By automatic, we mean that these devices are "smart" enough to know whether you want to run them as 2 channel crossovers, or as single channel units. They "know" by the way the jacks are inserted into them how your system is to be configured. However, just because they are automatic, doesn't mean that they will not automatically confuse you when you try to connect them in a bench test situation.

For instance, on most benches there is a signal source of some kind, usually with a single connector on it to drive one input of the device to be tested. Plugging this single connector in to channel 1 of the AC 22 or the AC 23 and nothing in to channel 2 tells the units that you are running a single channel system and therefore sets the unit up to be a single channel device. This can lead one to think that there are some dead channels in the unit when looking for output in places where there shouldn't be any.

In the case of the AC 22, everything will look as you would expect if you drive both channel one and two. There will be signal present at all four outputs in this situation. If only channel one is driven, there will be useable output at only the channel one LOW OUT (LOW OUT M3W), channel two LOW OUT (MID OUT M3W) and the channel two HIGH OUT (HIGH OUT M3W). The unuseable output appears at channel one's high out. It is simply the high-pass portion of the midrange filter.

Driving only channel two connects both channels together on the AC 22. This is very useful in situations where only one mix exists, but two independent channels of crossover are desired, normally used for separate amplification on each side of a stage. This is a good way to test both channels of the crossover when only one signal source exists.

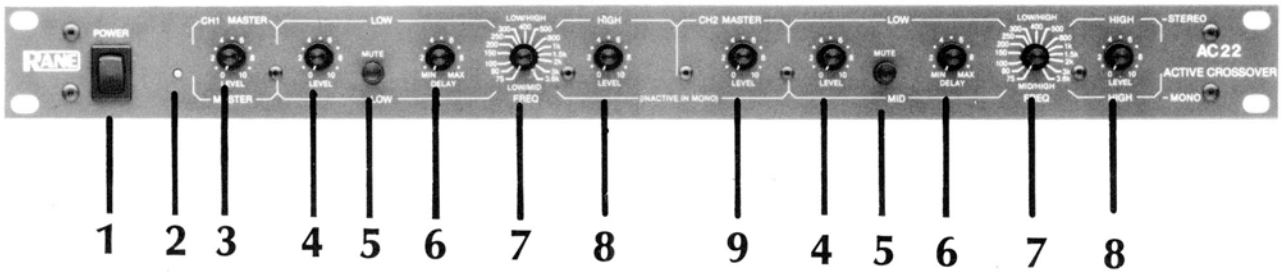
The AC 23 presents an even bigger challenge on the bench. Plugging a single signal source in to the device again tells it that it is running as a single channel 4 or 5-way unit. That's the easy part. The even more automatically confusing part is the way that the output connectors decide whether the unit is a 4-way or 5-way crossover. It is actually rather straight forward.

To test the unit as a mono 4 -way, connect the input source to channel one only, look at channel one's LF OUT (SUB OUT M4W), then look at channel two's LF OUT (LF OUT M4W), now go back to channel one's MF OUT (MF OUT M4W), and then proceed on the channel two's HF OUT (HF OUT M4W). So far, so good.

To test the unit as a mono 5-way, the only precaution that is required is that there must be a "dummy" jack inserted into the channel two MF OUT (HI-MF OUT M5W) to program the crossover properly. When you reach the point where you want to measure the output of the channel with the dummy in it, simply remove it and insert your test output jack in that location.

II. PANEL DESCRIPTIONS

AC 22: 2-Channel 2-Way Configuration



1. POWER SWITCH: Self-evident.

2. POWER INDICATOR: When this yellow LED is lit, all output muting circuits are fully "on" and the unit is ready to operate.

3. CH. 1 MASTER LEVEL CONTROL: This controls the overall level of Channel 1 without altering the relative settings of the Hi and Low outputs.

4. LOW FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Low Frequency driver only in this channel.

5. LOW FREQUENCY MUTE SWITCH: When pressed to the IN position, all signal is removed from the Low Frequency output. This eases tune-up procedure, as described in Section III-4.

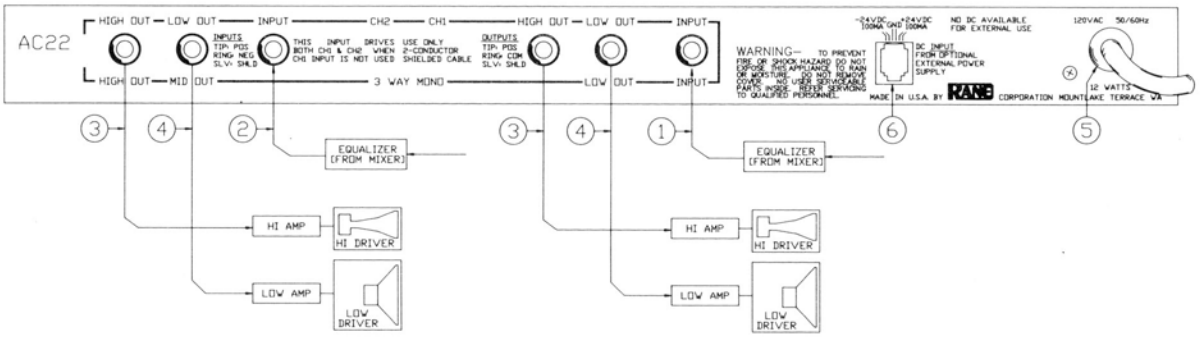
6. LOW FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Low Frequency output only. This allows a low frequency driver to be electronically phase-aligned with a high frequency driver whose diaphragm is situated BEHIND the low frequency diaphragm. Refer to Section III-3 for alignment procedure.

7. CROSSOVER FREQUENCY SELECTOR: This 41-detent selector determines the crossover frequency between low and high frequency drivers. The detents will assure maximum accuracy and consistency between channels. Refer to Section III-2 to determine proper crossover frequency for your particular system.

8. HIGH FREQUENCY LEVEL CONTROL: This controls the level of signal going to the High Frequency driver only in this channel.

9. CH. 2 MASTER LEVEL CONTROL: This controls the overall level of Channel 2 without altering the relative settings of the Hi and Low outputs.

AC 22 2-Channel 2-Way Installation



Observe the labels ABOVE the inputs and outputs for 2-channel operation.

1. CHANNEL 1 INPUT: Use this input only if you are running true stereo: two separate channels from the mixer or other source. Connect this input to the left channel output of the mixer, equalizer or other signal source. **If you are running two speaker systems from a single mono signal, omit this input and use only Channel 2 input. See #2 below.**

2. CHANNEL 2 INPUT: For true stereo operation, connect this input to the right channel output of the mixer, equalizer or other signal source. **NOTE: Two separate speaker systems may be independently operated from a single mono source by using only the Channel 2 input and omitting the Channel 1 input.** As long as nothing is plugged into the Channel 1 input, Channel 2 will drive BOTH channels of the AC 22 internally, eliminating the need for an external "Y" adapter to run both channels from a single input.

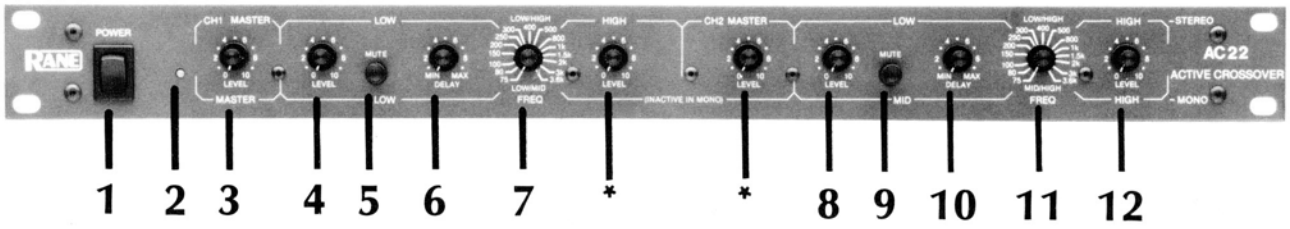
3. HIGH FREQUENCY OUTPUTS: Connect the Channel 1 High output to the left channel input of the high frequency amplifier, and the Channel 2 High output to the right channel input of the high frequency amp.

4. LOW FREQUENCY OUTPUTS: Connect the Channel 1 Low output to the left channel input of the low frequency amplifier and the Channel 2 Low output to the right channel input of the low frequency amp.

5. AC POWER LINE CORD: Plug this into a 120 VAC wall outlet.

6. EXTERNAL POWER JACK: Use **only** with Rane RS 10 Power Supply (See Rane Note 118 for details). **Cannot be used to power other units.** —WARNING: DO NOT PLUG ANY TYPE OF TELEPHONE EQUIPMENT TO THIS JACK.—

AC 22: Mono 3-Way Configuration



1. POWER SWITCH: Self-evident.

2. POWER INDICATOR: When this yellow LED is lit, all output muting circuits are fully "on" and the unit is ready to operate.

3. CH. 1 MASTER LEVEL CONTROL: This controls the overall level without altering the relative settings of the Hi, Mid and Low outputs.

4. LOW FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Low Frequency driver.

5. LOW FREQUENCY MUTE SWITCH: When pressed to the IN position, all signal is removed from the Low Frequency output. This eases tune-up procedure, as described in Section III-4.

6. LOW FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Low Frequency output only. This allows a low frequency driver to be electronically phase-aligned with a high frequency driver whose diaphragm is situated BEHIND the low frequency diaphragm. Refer to Section III-3 for alignment procedure.

7. CROSSOVER FREQUENCY SELECTOR: This 41-detent selector determines the crossover frequency between low and mid frequency drivers. The detents will assure maximum accuracy and consistency between channels. Refer to Section III-2 to determine proper crossover frequency for your particular system.

8. MID FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Mid Frequency driver.

***NOTE: The Ch. 1 High Frequency level control and the Ch. 2 Master level control are automatically bypassed internally when the AC 22 is connected as shown by the diagram on the facing page. Adjusting these controls will have no effect in the Mono mode.**

Following

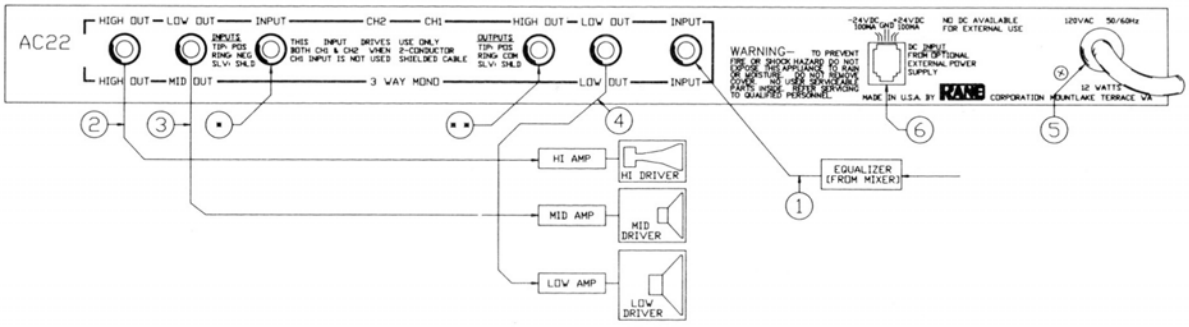
9. MID FREQUENCY MUTE SWITCH: When pressed to the IN position, all signal is removed from the Mid Frequency output. This eases tune-up procedures, as described in Section III-4.

10. MID FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Mid Frequency output only. This allows a mid frequency driver to be electronically phase-aligned with a high frequency driver whose diaphragm is situated BEHIND the mid frequency diaphragm. Refer to Section III-3 for alignment procedure.

11. CROSSOVER FREQUENCY SELECTOR: This sets the crossover frequency between the Mid and High Frequency drivers. Refer to Section III-2.

12. HIGH FREQUENCY LEVEL CONTROL: This controls the level of signal going to the High Frequency driver only.

AC 22 Mono 3-Way Installation



Observe the labels BELOW the inputs and outputs for Mono operation.

1. MONO (CH. 1) INPUT: Plug the output of the mixer, equalizer or other signal source into this input for mono operation. **DO NOT PLUG INTO THE CHANNEL 2 INPUT: THIS INPUT IS USED TO DRIVE TWO CHANNELS WITH THE SAME MONO INPUT.** Refer to "AC 22 2-Channel 2-Way Installation".

***DO NOT USE THIS INPUT FOR 3-WAY MONO OPERATION. USE THE CHANNEL 1 INPUT ONLY.**

2. HIGH FREQUENCY OUTPUT: Connect this output to the input(s) of the high frequency amplifier.

3. MID FREQUENCY OUTPUT: Connect this output to the input(s) of the mid frequency amplifier.

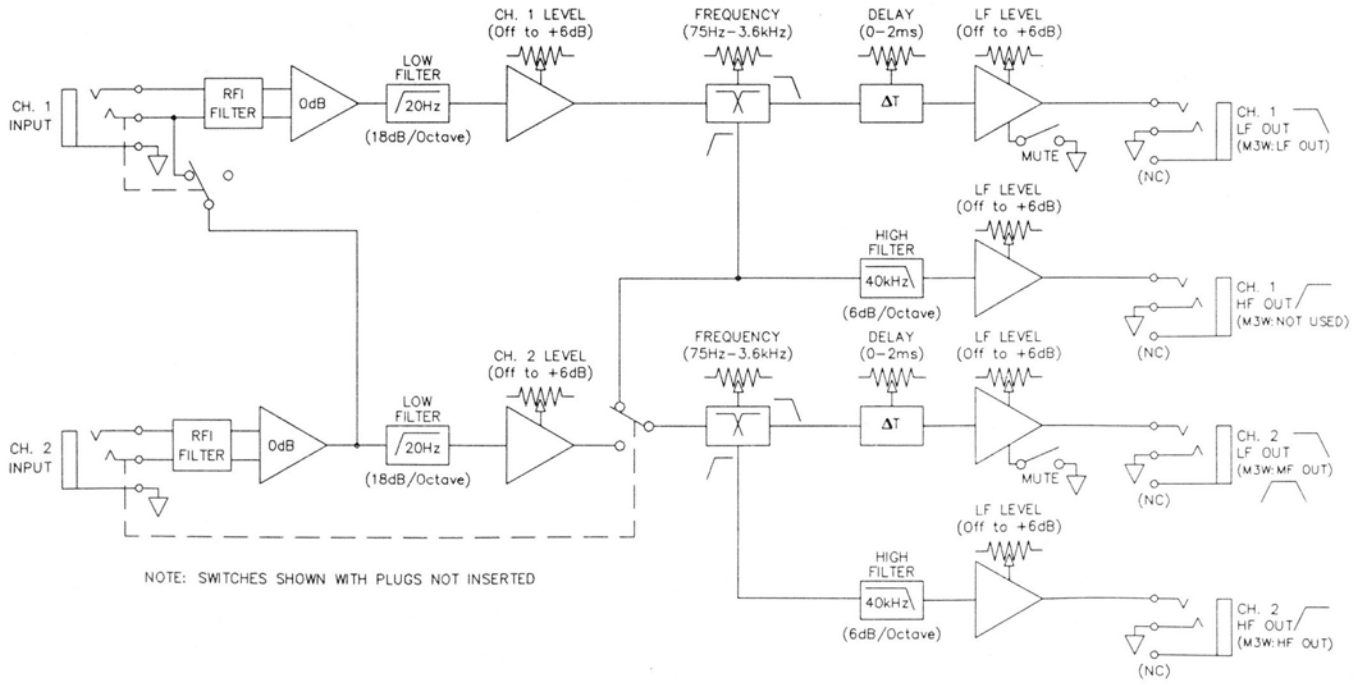
4. LOW FREQUENCY OUTPUT: Connect this output to the input(s) of the low frequency amplifier.

****This output is not used in the Mono 3-Way mode.**

5. AC POWER LINE CORD: Plug this into a 120 VAC wall outlet.

6. EXTERNAL POWER JACK: Use **only** with Rane RS 10 Power Supply (See Rane Note 118 for details). **Cannot be used to power other units.** —WARNING: DO NOT PLUG ANY TYPE OF TELEPHONE EQUIPMENT TO THIS JACK.—

AC 22 BLOCK DIAGRAM



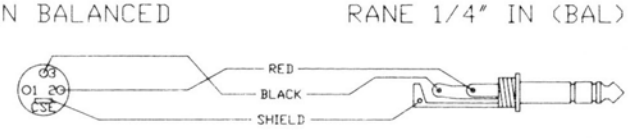
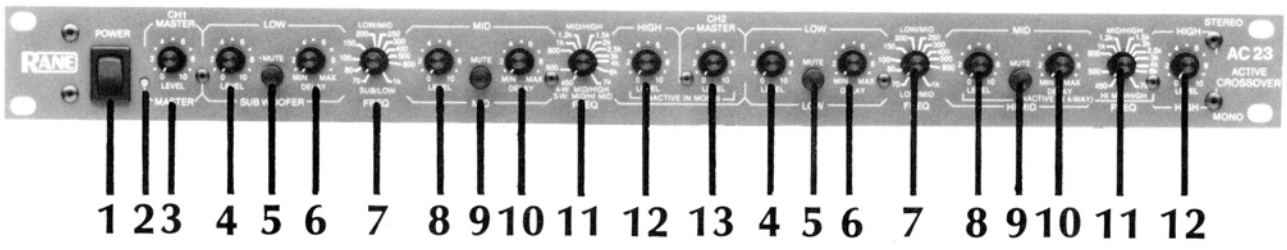


DIAGRAM II-1. Wiring connections for balanced input or floating output operation.

See Rane Note 110 for other configurations.

AC 23: 2-Channel 3-Way Configuration



1. POWER SWITCH: Two guesses.

2. POWER INDICATOR: When this yellow LED is lit, all output muting circuits are fully "on" and the unit is ready to operate.

3. CH. 1 MASTER LEVEL CONTROL: This controls the overall level of Channel 1 without altering the relative settings of the High/Mid/Low frequency outputs.

4. LOW FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Low Frequency driver only in this channel.

5. LOW FREQUENCY MUTE SWITCH: When pressed to the IN position, all signal is removed from the Low Frequency output. This eases tune-up procedures as described in Section III-4.

6. LOW FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Low Frequency output only. This allows a low frequency driver to be electronically phase-aligned with a mid frequency driver whose diaphragm is situated BEHIND the low frequency diaphragm. Refer to Section III-3 for alignment procedure.

7. LOW/MID CROSSOVER FREQUENCY SELECTOR: This 41-detent selector sets the crossover frequency between the Low and Mid frequency drivers. Refer to Section III-2.

8. MID FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Mid Frequency driver in this channel only.

9. MID FREQUENCY MUTE SWITCH: Removes all signal from the Mid Frequency output when pressed to the IN position.

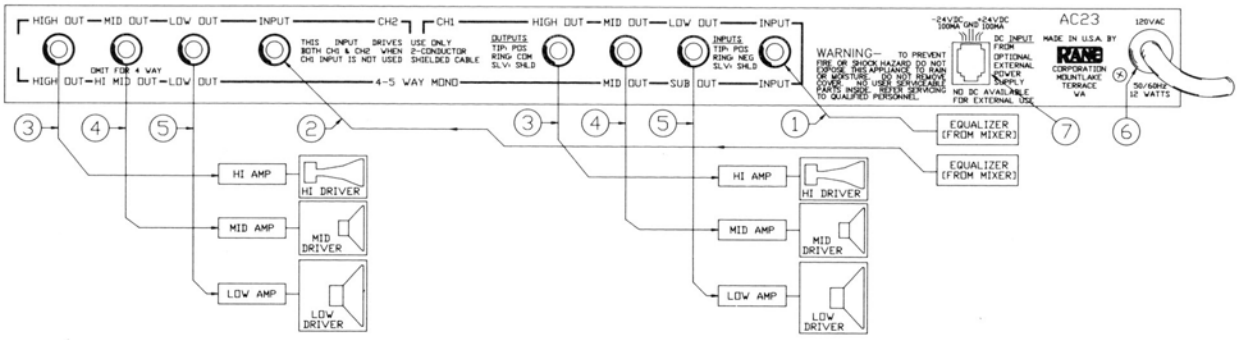
10. MID FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Mid Frequency output only. Refer to Section III-3 for alignment procedure.

11. MID/HIGH CROSSOVER FREQUENCY SELECTOR: This control sets the crossover frequency between the mid and high frequency drivers in this channel. Refer to Section III-2.

12. HIGH FREQUENCY LEVEL CONTROL: This controls the level of signal going to the High Frequency driver only.

13. CH. 2 MASTER LEVEL CONTROL: This controls the overall level of Channel 2 without altering the relative settings of the High/Mid/Low outputs.

AC 23 2-Channel 3-Way Installation



Observe the labels ABOVE the inputs and output for 2-channel operation.

1. CHANNEL 1 INPUT: Use this input only if you are running true stereo: two separate channels from the mixer or other source. Connect this input to the left channel output of the mixer, equalizer or other signal source. If you are running two speaker systems from a single mono signal, omit this input and use only the Channel 2 input. See #2 below.

2. CHANNEL 2 INPUT: For true stereo operation, connect this input to the right channel output of the mixer, equalizer or other signal source. **NOTE: Two separate speaker systems may be independently operated from a single mono source by using only the Channel 2 input and omitting the Channel 1 input.** As long as nothing is plugged into the Channel 1 input, Channel 2 will drive BOTH channels of the AC 23 internally, eliminating the need for an external "Y" adapter.

3. HIGH FREQUENCY OUTPUTS: Connect the Channel 1 High Out to the left channel input of the high frequency amplifier, and the Channel 2 High Out to the right channel input of the high frequency amp.

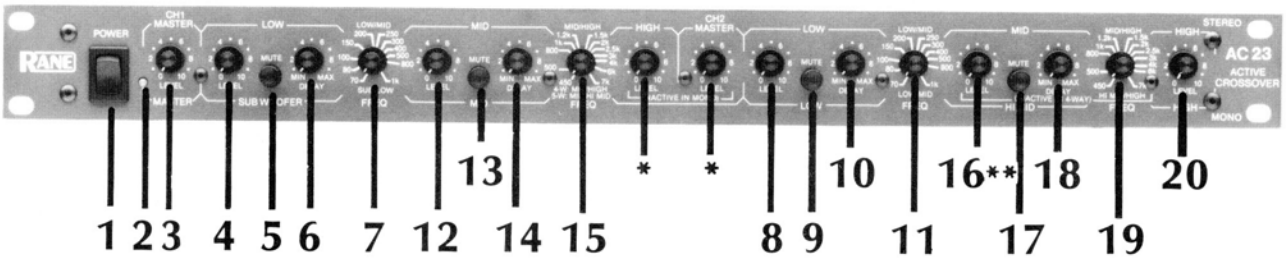
4. MID FREQUENCY OUTPUT: Connect the Channel 1 Mid Out to the left channel of the mid frequency amplifier, and the Channel 2 Mid Out to the right channel of the mid amp.

5. LOW FREQUENCY OUTPUTS: Connect the Channel 1 and 2 Low Outs to the left and right channels of the low frequency amplifier, respectively.

6. AC POWER LINE CORD: Plug this into a 120 VAC wall outlet.

7. EXTERNAL POWER JACK: Use **only** with Rane RS 10 Power Supply (See Rane Note 118 for details). **Cannot be used to power other units.** —WARNING: DO NOT PLUG ANY TYPE OF TELEPHONE EQUIPMENT TO THIS JACK.—

AC 23: Mono 4-Way and 5-Way Configuration



Observe the labels screened BELOW the knobs for Mono 4-way operation.

1. POWER SWITCH: Two guesses.

2. POWER INDICATOR: When this yellow LED is lit, all output muting circuits are fully "on" and the unit is ready to operate.

3. MASTER LEVEL CONTROL: This controls the overall level of the entire unit in the Mono configuration, without changing the relative settings of the individual Sub/Low/Mid/High outputs.

4. SUB-WOOFER LEVEL CONTROL: This controls the level of signal going to the Sub-woofer only.

5. SUB-WOOFER MUTE SWITCH: Removes all signal from the Sub-woofer output when pressed to the IN position. This eases the system tune-up procedure, as described in Section III-4.

6. TIME DELAY CONTROL: This control exists primarily for 3-way applications of the AC 23. In Sub-woofer applications this control will normally be set to minimum (MIN). Refer to Section III-3.

7. SUB/LOW CROSSOVER FREQUENCY SELECTOR: This 41-detent selector sets the crossover frequency between the Sub-woofer and Low frequency drivers. The detents will assure accuracy and consistency. Refer to Section III-2 to determine the proper crossover frequency points for the particular drivers in your system.

8. LOW FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Low Frequency driver only.

9. LOW FREQUENCY MUTE SWITCH: Removes all signal from the Low Frequency output when pressed to the IN position.

10. LOW FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Low Frequency output only. This allows a low frequency driver to be electronically phase-aligned with a mid frequency driver whose diaphragm is situated BEHIND the low frequency diaphragm. Refer to Section III-3 for alignment procedure.

11. LOW/MID CROSSOVER FREQUENCY SELECTOR: This control sets the crossover frequency between the Low and Mid frequency drivers. Refer to Section III-2.

12. MID FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Mid Frequency driver only.

13. MID FREQUENCY MUTE SWITCH: Removes all signal from the Mid Frequency output when pressed to the IN position.

14. MID FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Mid Frequency output only. This allows a mid frequency driver to be electronically phase-aligned with a high frequency driver whose diaphragm is situated BEHIND the mid frequency diaphragm. Refer to Section III-3 for alignment procedure.

15. MID/HI MID CROSSOVER FREQUENCY SELECTOR: This control sets the crossover frequency between the Mid and Hi Mid frequency drivers.

***NOTE: Both the Ch.1 High frequency level control and Ch.2 Master level control are automatically bypassed internally when the AC 23 is connected as shown by the diagram on facing page. Adjusting these controls will have no effect in the Mono mode.**

16. HI MID FREQUENCY LEVEL CONTROL: This controls the level of signal going to the Hi Mid frequency driver only.

17. HI MID FREQUENCY MUTE SWITCH: Removes all signal from the Hi Mid Frequency output when pressed to the IN position.

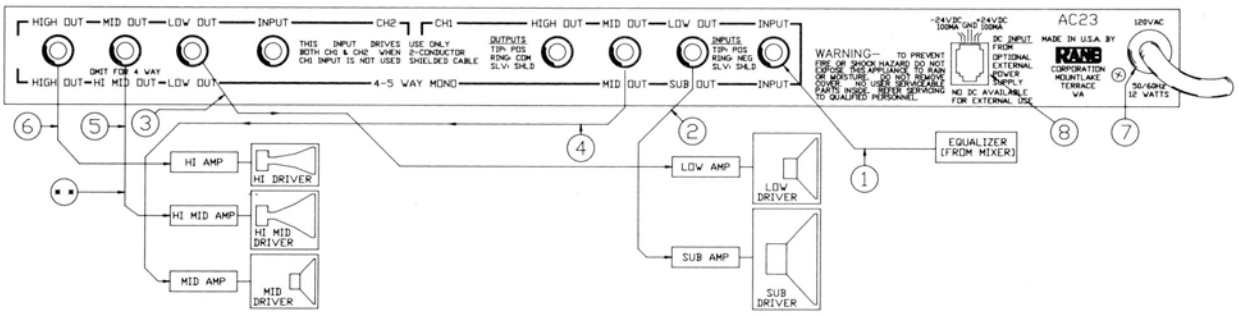
18. HI MID FREQUENCY TIME DELAY CONTROL: This control adds from 0 to 2mS of time delay to the Hi Mid Frequency output only. Refer to Section III-3 for alignment procedure.

19. HI MID/HIGH CROSSOVER FREQUENCY SELECTOR: This control sets the crossover frequency between the Hi Mid and High Frequency drivers.

20. HIGH FREQUENCY LEVEL CONTROL: This controls the level of signal going to the High Frequency driver only.

****NOTE: When the AC 23 is connected for Mono 4-way operation as shown by the diagram on the facing page (with no connection made to the Hi Mid output on the rear panel), the entire Hi Mid section is bypassed automatically through internal switching. The Hi Mid level control, Hi Mid mute switch, Hi Mid time delay control and Hi Mid/High crossover frequency selector are out of circuit and will have no effect regardless of their settings.**

AC 23 Mono 4-Way or Mono 5-Way Installation



Observe the labels BELOW the inputs and outputs for mono operation.

1. MONO INPUT: Use only this input for mono operation; do not use the Channel 2 input. **As long as no plug is inserted into the Channel 2 input the AC 23 will internally switch itself to mono operation.** Refer to the AC 23 block diagram for further details.

2. SUB WOOFER OUTPUT: Connect this output to the input of the sub-woofer amplifier (or bass bin amp).

3. LOW FREQUENCY OUTPUT: Connect this output to the input of the low frequency (or mid-bass) amplifier.

4. MID FREQUENCY OUTPUT: Connect this output to the input of the mid frequency amplifier.

5. HI MID FREQUENCY OUTPUT (FOR MONO 5-WAY ONLY): Use this output only for mono 5-way applications. **OMIT THIS OUTPUT WHEN USING THE AC 23 AS A MONO 4-WAY CROSSOVER. AS LONG AS NO PLUG IS INSERTED INTO THIS JACK THE AC 23 INTERNALLY BYPASSES THE HI MID SECTION AND DEFEATS ALL FRONT PANEL HI MID CONTROLS.** For mono 5-way connect this output to the input of the Hi Mid frequency amplifier.

6. HIGH FREQUENCY OUTPUT: Connect this output to the input of the high frequency (or tweeter) amplifier.

7. AC POWER LINE CORD: Plug this into a 120 VAC wall outlet.

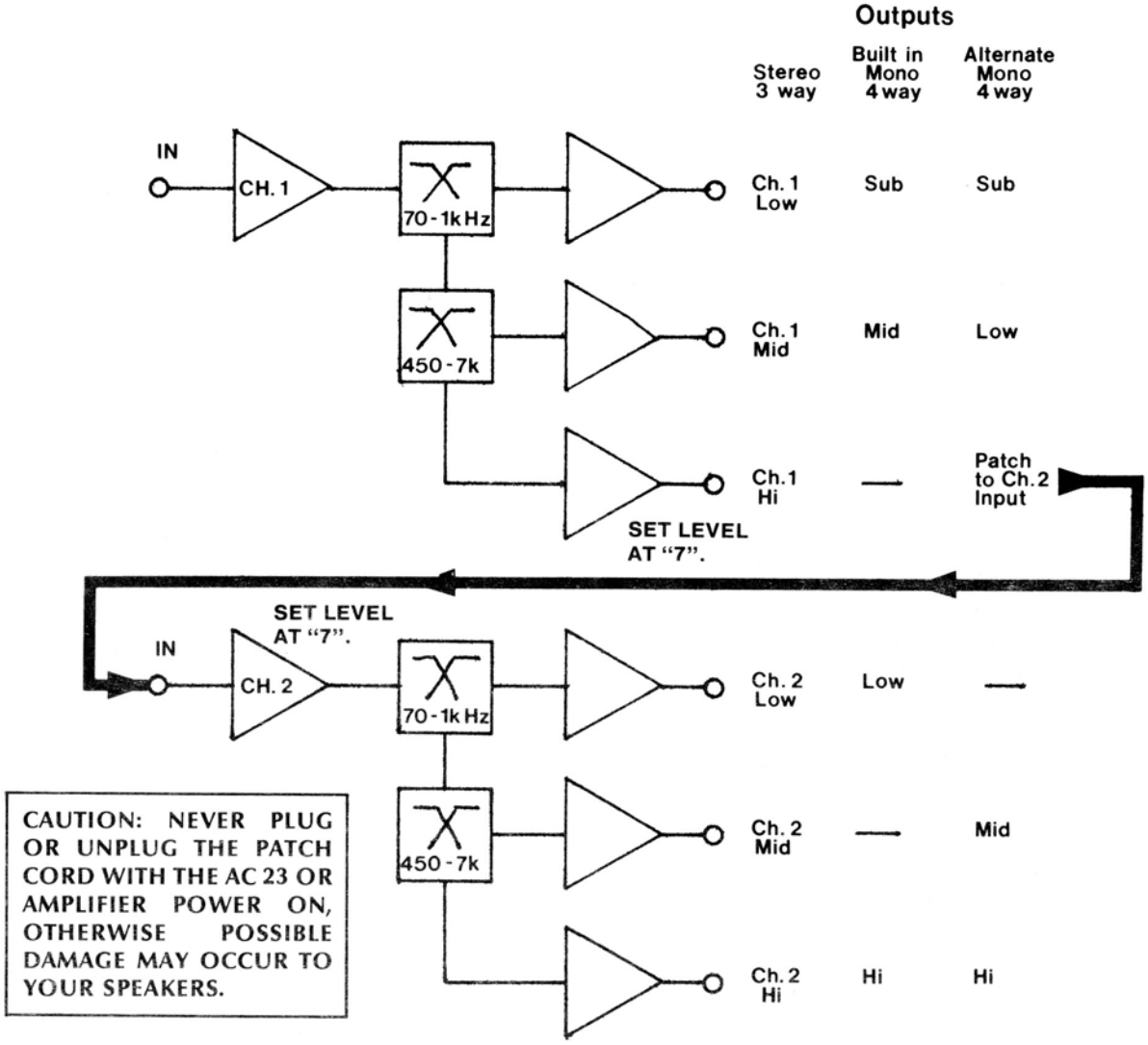
8. EXTERNAL POWER JACK: Use **only** with Rane RS 10 Power Supply (See Rane Note 118 for details). **Cannot be used to power other units.** —WARNING: DO NOT PLUG ANY TYPE OF TELEPHONE EQUIPMENT TO THIS JACK.—

****DO NOT INSERT ANY PLUG INTO THIS OUTPUT FOR 4-WAY MONO OPERATION.**

AC 23 ALTERNATE MONO 4-WAY HOOKUP

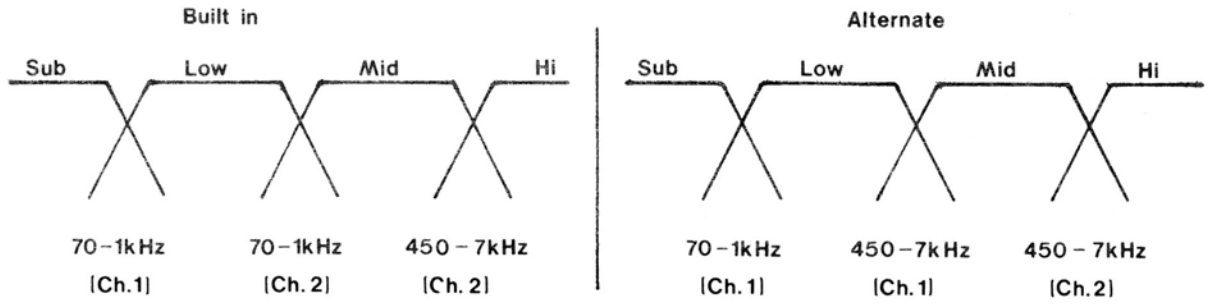
The internal switching in the AC 23 will result in a mono 4-way configuration with the crossover ranges as shown below. By connecting a patch cable from the Channel 1 Hi Output to the Channel 2 Input, the Low/Mid crossover range changes from 70 — 1kHz to a higher range of 400 — 7kHz.

WARNING: NEVER OPERATE AC 23 IN ALTERNATE MONO 4-WAY MODE WITH CH. 1 INPUT OPEN. OTHERWISE A POSSIBLY DESTRUCTIVE OSCILLATION MAY OCCUR.

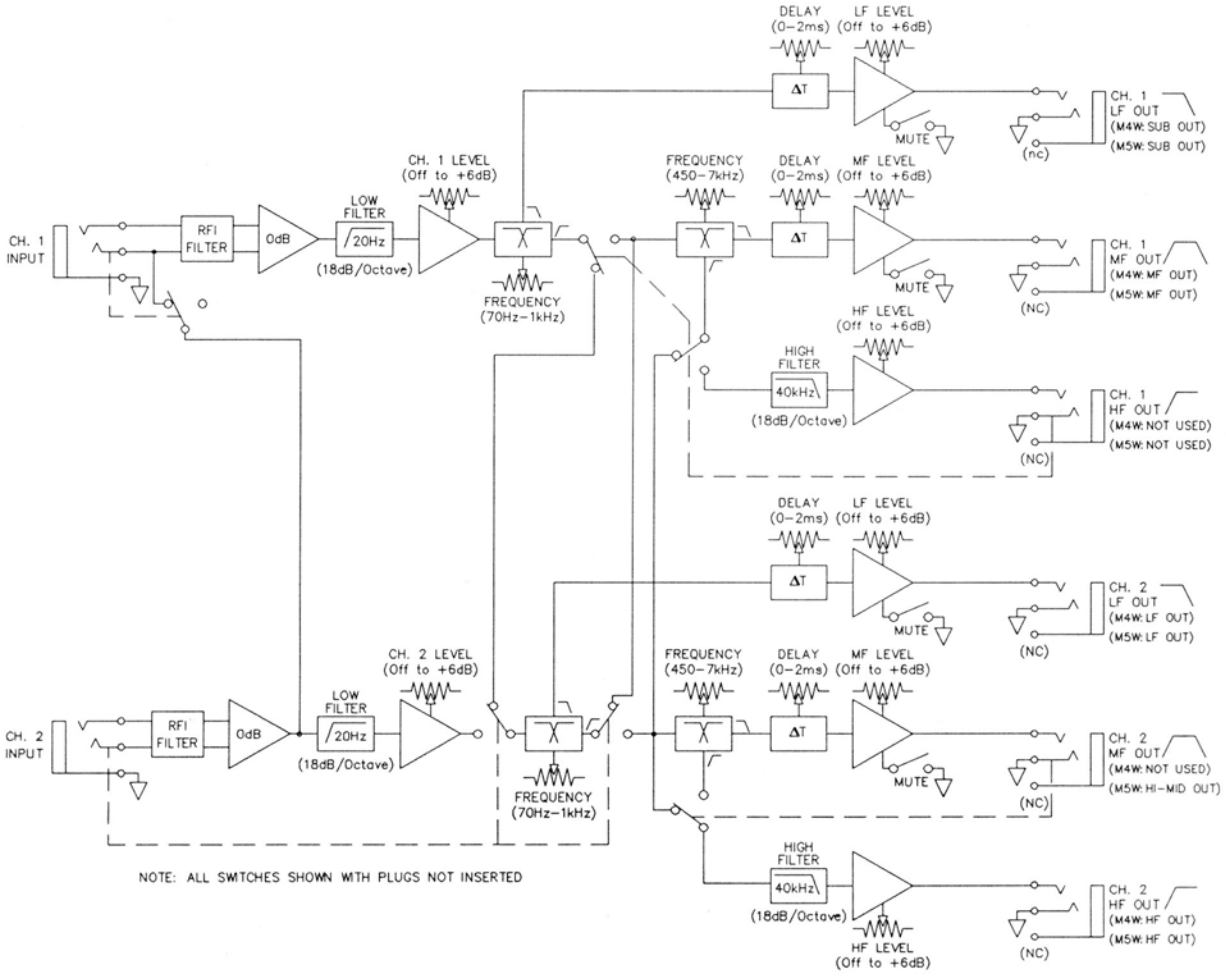


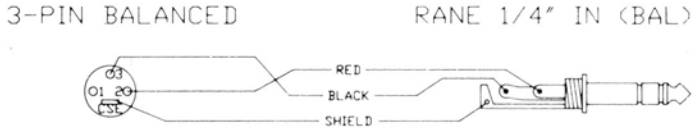
CAUTION: NEVER PLUG OR UNPLUG THE PATCH CORD WITH THE AC 23 OR AMPLIFIER POWER ON, OTHERWISE POSSIBLE DAMAGE MAY OCCUR TO YOUR SPEAKERS.

Mono 4-way Crossover Ranges



AC 23 BLOCK DIAGRAM


DELAY (0–2ms)
LF LEVEL (Off to +6dB)
ΔT
MUTE
CH. 1 LF OUT (M4W: SUB OUT) (M5W: SUB OUT)
(nc)
CH. 1 LEVEL (Off to +6dB)
LOW FILTER
20Hz
(18dB/Octave)
CH. 1 INPUT
RFI FILTER
0dB
FREQUENCY (70Hz–1kHz)
FREQUENCY (450–7kHz)
DELAY (0–2ms)
MF LEVEL (Off to +6dB)
CH. 1 MF OUT (M4W: MF OUT) (M5W: MF OUT)
(NC)
HF LEVEL (Off to +6dB)
HIGH FILTER
40kHz
CH. 1 HF OUT (M4W: NOT USED) (M5W: NOT USED)
DELAY (0–2ms)
LF LEVEL (Off to +6dB)
CH. 2 LF OUT (M4W: LF OUT) (M5W: LF OUT)
CH. 2 LEVEL (Off to +6dB)
CH. 2 INPUT
FREQUENCY (450–7kHz)
DELAY (0–2ms)
MF LEVEL (Off to +6dB)
CH. 2 MF OUT (M4W: NOT USED) (M5W: HI–MID OUT)
HF LEVEL (Off to +6dB)
CH. 2 HF OUT (M4W: HF OUT) (M5W: HF OUT)
NOTE: ALL SWITCHES SHOWN WITH PLUGS NOT INSERTED



See Rane Note 110 for other configurations.

DIAGRAM II-1. Wiring connections for balanced input or floating output operation.

III. SYSTEM ALIGNMENT

III-1. Choosing the Right Crossover Configuration: Mono, 2-channel Mono or True Stereo?

Very few systems indeed will utilize a 2-channel crossover for the purpose of true stereo imaging. Discrete stereo channels which are run from the mixing board are usually used for panning effects and/or for separate equalization of left and right speaker stacks. Different sides of the room often require significantly different equalization due to varying room acoustics, dimensions, positioning of speaker stacks near walls, curtains and the like.

Even though you may not plan to use stereo equalization or panning effects, it is recommended that your system utilize discrete crossover channels for each stack of speakers to ensure flexibility and control for consistent, optimum sound quality. For example, if you plan to run a system mono three-way, use the AC 23 rather than the AC 22, for separate control over each set of speakers -- especially since phase alignment may differ with each stack requiring separate time delay adjustments. Even with only a single system equalizer, the AC 23 can give you the extra independent control which can make a difference in sound throughout the listening area. If all components are built into a single box, or you are running biamped monitors, then the AC 22 is the one for you.

III-2. Selecting Crossover Frequencies.

Most speaker manufacturers supply low and/or high frequency cut-off points for each driver, especially if these are supplied in a system. These cut-off frequencies are based on each driver's performance at and beyond this point, with a certain safety margin to accommodate more gentle filter roll-offs and resultant higher output beyond the recommended performance range.

The AC 22 and 23 utilize 41-detent crossover frequency selectors which are precision stepped attenuators. The detents will assure consistent accuracy from channel to channel and unit to unit. This is a distinct advantage over the continuously variable designs with low-tolerance parts, possible knob mis-alignment and panel screening variations. Even with 41 choices it is possible that the exact recommended crossover frequency may not fall on one of the detents on the selector. Not to panic, for these sound reasons:

1. Both the AC 22 and AC 23 possess 24 dB/octave roll-off, so the crossover points may be set to the nearest detent above or below the recommended limit with virtually no hazard to the driver or degradation in sound quality. If extremely high power levels are expected, it is safer to defer to the high frequency drivers and shift the crossover point UP in frequency rather than down.

2. Detents do not rely on knob alignment, silkscreen accuracy, parallax and other variables which erode the accuracy of continuously variable designs. Chances are that even careful visual alignment on these will often yield a frequency error greater than a full detent on the AC 22 or 23.

3. If it is absolutely critical to obtain the exact crossover frequency (Mil Spec P.A. ...), the selector CAN BE POSITIONED BETWEEN DETENTS if necessary. This of course will require the aid of a precision signal generator and other equipment to verify the exact setting.

For best overall system results, try to choose the speaker components so that each operates well within its recommended limits. This will provide valuable leeway so that you may move crossover points in order to fine-tune the system, and will also yield higher system reliability. If at all possible, beg, borrow or best yet always use some kind of realtime analyzer to tune your crossover and fine-tune the system for each different location with an equalizer. Refer to Section III-3 and III-4 for further alignment details.

III-3. Time Delay Adjustment Procedures.

Before jumping feet first into the realm of time delay and how to adjust it, it might help to spend a moment here to re-affirm **why** on earth this delay is really necessary. For a detailed and enjoyable short course on time delay, Linkwitz-Riley and other mouth-watering details, we urge you to pick up a free copy of Rane Note 107. Ask your dealer or write to us here at the factory. In the way of summary, a few words are in order here to outline the basic effects of time delay in crossovers.

Problems pop up when two different speakers emit the same frequency as occurs in the crossover regions of two, three, four and five way systems. Because the two drivers are displaced vertically, cancellation occurs somewhere off-axis because the sound waves have to travel different distances from the two speakers and hence, will arrive out of phase. This forms a "lobe" or radiation pattern, bounded on either side by cancellation lines or axes, which narrow the dispersion pattern or listening area of the speaker.

Fine. So we put up with it. But to make matters worse, when the two drivers are **horizontally** displaced -- that is, one is in the front of or behind the other, this "lobe" or dispersion pattern gets TILTED (usually upward) toward the driver that is further behind. This gets hard to put up with, because the end result is that your speaker system will have two, three, four or more tilted radiation patterns and only two or three people in the house will have decent seats. And we're not talking trivial pursuits here -- this rampant lobing error can make a sound system a real headache, to listener and operator alike.

The idea, then, is to be sure that all drivers are vertically aligned and that all components are always in phase. Then all the main lobes are on-axis, well behaved, and the system enjoys the widest possible dispersion pattern so that everyone gets good sound. The one catch is that in many cases it is physically or otherwise impossible to get all the drivers vertically lined up at the sound source. THIS is where time delay comes in.

By electronically delaying the signal going to the driver up front, enough time is allowed for the sound from the rear driver to literally catch up to the forward driver's voice coil, so that signal from both drivers is emitted in phase. And it works! Time delay can make an appreciable improvement in overall sound. The trick is finding the proper amount of time delay: hence the rest of this section.

Unfortunately the amount of time delay is a function of TWO factors (life ceased to be simple after age 9, right?): the amount of horizontal displacement between driver voice coils, AND the actual crossover frequency involved. Setting delay controls by ear is supposedly possible, but VERY tricky and unreliable. The following methods are a couple of (but by no means all) means of setting time delay.

III-3.1. Time Delay Adjustment Using Realtime Analyzer and Pink Noise.

This method outlines the use of a realtime analyzer, pink noise generator and flat response microphone to set crossover time delay. Some references will be made to Rane Models RE 27, RE 14 and RA 27 analyzer systems for those with the intelligence and good taste to use one of these regularly. The procedure applies to virtually any analyzer system. We recommend using a one-third or two-thirds octave analyzer as either of these is more likely to match your specific crossover points than a one-octave analyzer. And it IS important to match the analyzer to the crossover point as closely as possible for proper phase alignment, otherwise the analyzer readings may be misleading.

DELAY VS. FREQUENCY TABLE

If you do not have the equipment necessary to electronically align the system as described in sections III-3.1 and III-3.2, you may use the table below to obtain a ROUGH AND APPROXIMATE phase alignment of your drivers. Measure the horizontal displacement between the voice coils of the two adjacent drivers sharing the same crossover point, then find the column in the table nearest your actual displacement. Move down this column to the proper crossover frequency as indicated on the left of the table: the corresponding delay knob setting will then be the closest for your system. For example, if you have a two-way system crossed over at 800 Hz with the compression driver voice coil located about 9" behind the woofer voice coil, the delay knob setting corresponding to a 9" displacement at 800 Hz on the table would be 5 as indicated on the front panel.

	VOICE COIL DISPLACEMENT (INCHES)									
(Hz)	.75"	1.5"	3"	6"	9"	12"	15"	18"	21"	24"
70	1	1.5	2	2.5	3.5	5	6	7	8	MAX
80	1	1.5	2	2.5	3.5	5	6	7	8	MAX
100	1	1.5	2	2.5	3.5	5	6	7	8	MAX
150	1	1.5	2	2.5	3.5	5	6	7	MAX	
200	1	1.5	2	2.5	3.5	5	6	7	MAX	
250	1	1.5	2	2.5	3.5	5	7	8	MAX	
300	1	1.5	2	2.5	3.5	5.5	7	MAX		
400	1	1.5	2	2.5	4	6	8	MAX		
450	1	1.5	2	2.5	4	6	8	MAX		
500	1	1.5	2	2.5	4	6	8	MAX		
800	1	1.5	2	3	5	7	MAX			
1k	1	1.5	2.2	3	6	MAX				
1.2k	1	1.5	2.2	3.5	MAX					
1.5k	1	1.5	2.3	3.5	MAX					
2k	1	1.5	2.3	MAX						
2.5k	1	1.5	2.3	MAX						
3k	1	1.7	2.4	MAX						
3.6k	1	1.7	MAX							
4k	1	1.8	MAX							
6k	1	2	MAX							
7k	1.2	MAX								

SUMMARY

In order to phase-align two drivers you must observe **only** the crossover frequency, which is common to both drivers. Pink noise can be used if all other frequencies are disregarded, since room acoustics and imperfect driver response will cause erroneous alignment attempts. Using pink noise as a source, each driver is individually tuned to an arbitrary OdB level on the analyzer display **ONLY AT THE CROSSOVER FREQUENCY.** When both are turned on simultaneously, the combined response of the two drivers should read +3dB higher at the crossover frequency on the display. If the drivers are not phase-aligned, some cancellation will occur on-axis, resulting in a combined response less than +3dB. Turning up the delay control causes the lower driver to electronically move backward until the analyzer reads +3dB; then the two drivers are electronically aligned and the on-axis cancellation is eliminated.

STEP BY STEP PROCEDURE*

1. Set the analyzer microphone about 15 feet in front of the speaker stack and at a height about midway between the Hi and Mid drivers. Turn all crossover level controls fully down.

2. Connect the pink noise source to the input of the crossover (or mixer or wherever is convenient). Turn up the crossover input level control and the Mid frequency output control until noise is heard from ONLY the Mid driver.

NOTE: If you are running two separate channels on the crossover, tune up only ONE channel at a time, using the same procedure for both.

*A three-way mode consisting of Hi, Mid and Low drivers is used as an example in this procedure. For other configurations, use the same procedure starting with the highest crossover point and repeating steps 2 through 5 for each lower crossover point.

3. With a healthy but not uncomfortable volume of noise from the Mid driver, set the analyzer display level control such that the LEDs corresponding to the high crossover frequency are reading OdB (this would be a green LED at the crossover frequency with any of the Rane analyzers set in the ±1dB mode.) For example, if your high crossover frequency is 2 k Hz, set the RE 27/RE 14/RA 27 in the ±1dB mode and then adjust the RTA Level control until the green LED is lit in the 2k Hz band. There ... easy.

4. Now press in the Mid frequency Mute switch on the crossover so that the tone is removed from the Mid driver. **Without re-adjusting either the meter or the crossover input or Mid frequency level controls,** turn up the Hi level control until the tone coming from only the Hi driver reads 0dB (a green LED at the crossover frequency).

5. Now release the Mid Mute switch on the crossover so that pink noise is heard from BOTH the Hi and Mid drivers. Switch the display sensitivity to ±3dB on Rane analyzers (not necessary with full scale analyzers) and observe the display reading at the crossover frequency:

A. If the display shows a +3dB reading (red LED on with Rane analyzers in the ±3dB mode) then the drivers are properly phase aligned and no delay is necessary; leave the Mid delay control at minimum.

B. If the display shows LESS THAN +3dB reading (still in green or in yellow on Rane analyzers), slowing turn up the Mid frequency delay control on the crossover until the display shows +3dB (Red LED just on with Rane analyzers). Now the drivers are electronically phase aligned and the delay control should be left in this position at all times unless the speaker system is physically altered.

C. If you have turned the Mid delay control all the way up and still do not have a +3dB (red) reading, you will have to physically move the Hi driver farther FORWARD until the display shows +3dB (red). The amount of displacement correction available from the delay depends on the actual crossover frequency: the higher the frequency the less amount of correction capability. Refer to Diagram III-3. If the drivers are built into a single cabinet and/or it is impossible to change relative positions, then you will have to obtain additional delay to achieve proper phase alignment. Rane's Model CD 48 Delay Console or other delay source should be used -- consult your local dealer.

D. If turning the Mid delay control **UP** makes the display reading **DECREASE** instead of increase, this means that the Hi driver is actually in FRONT of the Mid driver; adding delay to the Mid driver then only worsens the situation. There are a couple of ways to deal with this:

1. Try to move the Hi driver back as far as possible without losing stability in balancing the speaker stack. You may want to raise it up as well to restore dispersion close to the stack. If you cannot move the Hi driver, then you will have to obtain an additional delay source, such as the Rane CD48 or equivalent to align the Hi and Mid drivers. The built-in delay system in the AC 22 and AC 23 is designed to accommodate the majority of common speaker configurations; if you encounter confusion or difficulty with your particular system, it is best to consult your dealer or the Rane factory for assistance.

2. If this decrease in the display due to the delay control occurs at a low frequency crossover point below about 150Hz, set the delay control to minimum and leave it there. Frequencies below 150Hz are actually omnidirectional, so that phase misalignment is virtually inaudible below this point. Sub-woofers will often possess long folded or straight horns, resulting in the diaphragm being well behind the rest of the stack. Most authorities agree that phase alignment of sub woofers is unnecessary. Otherwise you will have to obtain additional delay equipment to align these to the rest of the system.

6. Lower the microphone until it is vertically midway between the Mid and Low drivers (or the drivers sharing the next lower crossover point if you are running 4 or 5 way system). Repeat steps 2 through 5, using the crossover level control, mute switch and next delay control. You may start each series of steps 2 through 5 at a different volume as necessary -- but once the levels are set in step 3 do not alter these until step 5 is completed. Once all of the crossover delay controls are set, then re-adjust the output level controls as outlined in Section III-4.

III-3.2. Time Delay Adjustment Using SPL Meter and Tone Generator

Now that good quality realtime analyzers are becoming more affordable and easier to use, there are few reasons why one of these should not be regularly used in any sound system. If an analyzer is simply not available or for some reason inappropriate, an accurate delay setting can be obtained by using a straightforward SPL meter (obtainable at most local electronics and some hi-fi stores) and some kind of variable tone generator.

SUMMARY: In order to exclude the effect of room acoustics and imperfect driver response, only the crossover frequencies are to be emitted (one at a time) by the tone generator. First the highest crossover frequency is run through the crossover and each of the two speakers sharing the crossover point is set SEPARATELY to an arbitrary 0dB level on the SPL meter. When both drivers emit the crossover tone simultaneously, the combined response should read +3dB higher on the meter. If the drivers are not phase aligned, some cancellation will occur on-axis, resulting in a combined response LESS than +3dB. Turning the delay control up causes the

lower frequency driver to electronically move backward until the SPL meter reads +3 dB; then the two drivers are electronically aligned and the on-axis cancellation is eliminated. This procedure is then repeated for the next lower crossover point(s).

STEP BY STEP PROCEDURE:*

1. Set the tone generator to the highest crossover frequency and plug it into the input of the crossover. Turn all crossover level controls fully down.

2. Position the SPL meter (microphone) about 15 feet in front of the speakers and at a height about midway between the Hi and Mid drivers. It is very important that the meter remain in exactly the same position throughout the test, so affix it to a mic stand, small tree or other stable object.

3. Slowly turn up both the crossover input control and the Mid frequency level control until the tone is heard through the Mid driver. Adjust the SPL meter control and/or the crossover level controls until you obtain a 0 dB reading on the meter. Verify that no sound is coming from any other speakers except the Mid driver.

4. Now press in the Mid frequency Mute switch on the crossover so that the tone is removed from the Mid driver. **Without re-adjusting either the meter or the crossover input or Mid frequency level controls,** turn up the Hi level control until the tone coming from only the Hi driver reads 0 dB on the SPL meter.

*A three-way mode consisting of Hi, Mid and Low drivers is used as an example in this procedure. For other configurations, use the same procedure starting with the highest crossover point and repeating steps 2 through 5 for each lower crossover point.

5. Now release the Mid Mute switch so that the tone is emitted from BOTH the Hi and Mid drivers. Check the reading on the SPL meter:

A. If the meter reads +3 dB, then the drivers are properly phase aligned and no delay is necessary; leave the Mid delay control at full minimum.

B. If the meter reads LESS THAN +3 dB, slowly turn up the Mid frequency delay control until the meter just reads +3 dB. Now the drivers are electronically phase aligned and the delay control should be left in this position at all times, unless the speaker system is physically altered.

C. If you have turned the Mid Delay control all the way up and still do not obtain a +3 dB reading, you will have to physically move the Hi driver farther forward until the SPL meter reads +3 dB. The amount of displacement corrections available from the delay depends on the actual crossover frequency: the higher the frequency the less amount of correction capability. Refer to Diagram III-3. If the drivers are built into a single cabinet and/or it is impossible to change relative positions, then you will have to obtain additional delay to achieve proper phase alignment. Rane's Model CD 48 Delay Console or other delay source should be used -- consult your local dealer.

D. If turning the Mid delay control up makes the SPL reading DECREASE instead of increase, this means that the Hi driver is actually IN FRONT of the Mid driver; adding delay to the Mid driver then only worsens the situation. There are a couple of ways to deal with this:

1. Try to move the Hi driver back as far as possible without losing stability in balancing the speaker stack. You may want to raise it up as well to restore dispersion close to the stack. If you cannot move the Hi driver, then you will have to obtain an additional delay source, such as the Rane C D48 or equivalent to align the Hi and Mid drivers. The built-in delay system in the AC 22 and AC 23 is designed to accommodate the majority of common speaker configurations; if you encounter confusion or difficulty with your particular system, it is best to consult your dealer or the Rane factory for assistance.

2. If this decrease in the display due to the delay control occurs at a low frequency crossover point below about 150Hz, set the delay control to minimum and leave it there. Frequencies below 150Hz are actually omnidirectional, so that phase misalignment is virtually inaudible below this point. Sub-woofers will often possess long folded or straight horns, resulting in the diaphragm being well behind the rest of the stack. Most authorities agree that phase alignment of sub woofers is unnecessary. Otherwise you will have to obtain additional delay equipment to align these to the rest of the system.

6. Tune the tone generator to the next lower crossover frequency and then repeat steps 2 through 5, using the appropriate level and delay controls. Once the delay control is set, you may re-adjust any of the crossover level controls at the beginning of each alignment procedure. Once all of the crossover delay controls are set, then re-adjust the output level controls as outlined in Section III-4.

Section III-4. Crossover Alignment Procedures: Setting the Output Level Controls

Choosing the crossover frequencies was the easy part. Now it gets real fun. The idea is to set the output level controls on the crossover so that the entire speaker system has a uniform, flat response. Unfortunately, the ROOM in which the speakers are placed has a habit of always getting into the act, so things get messy. As a result there seems to be two schools of thought regarding the use of active crossovers:

The Set-It-Once-And-Glue-It School. The philosophy here is to use the crossover to flatten system response as much as possible WITHOUT room acoustics involved. This means setting up the system outside (unless you happen to have a VERY large anechoic chamber handy) and with the aid of a realtime analyzer and pink noise source (ala RE 27) adjust all of the crossover outputs so that the system is as flat as possible. Once the system is tuned, the crossover is then locked behind a security cover (posted guard is optional) and never again touched. It is then the job of the system EQUALIZER(S) to normalize or flatten the system to each different room.

The Fix-It-With-The-Crossover School. Here the crossover knobs get a good workout, for the crossover is used at each location to help flatten the system along with the equalizer. Some even maintain that a good active crossover can work alone like a parametric equalizer in the hands of an expert. This does require experience, skill, and the right equipment to back it up (not to mention a licensed set of ears).

Regardless of which school you profess, the absolute importance and effectiveness of some kind of realtime analyzer in your system cannot be overstressed! No, this is not a callous plug for our other products; analyzers in general have come a long way. They're out of the lab (i.e. closet) and into the hands of every smart working musician and sound technician. An analyzer will save tremendous amounts of time and provide the absolute consistency, accuracy, and plain old good sound that very few ears on this earth can deliver. They are affordable, easy to use and amazingly effective. You owe it to yourself and your audience to at least look into one of these analyzers -- you'll wonder how you managed at all without one.

Whether by analyzer or by ear, here are a few recommended methods of setting the crossover output levels.

III-4.1. Using a Realtime Analyzer.

1. Set all level controls on the crossover to minimum; leave delay and crossover frequency controls as set in III-2 and III-3.
2. Set up the analyzer microphone at least 15 feet away from the speaker stack, on axis (dead ahead) and about chest level.
3. Run pink noise through the system, either through a mixer channel or directly into the crossover. Turn all amplifier controls at least 1/2 way up.
4. We will use the 3-way mode here as an example -- the procedure applies to all configurations. Turn up the INPUT level control(s) on the crossover about half way.
5. Slowly turn up the Low frequency output level control on the crossover, until you hear a healthy level of noise through the low frequency drivers (it should sound like rumble at this point).

NOTE: If you are running 2 channels, tune up only ONE channel at a time.

6. Adjust the display controls on the analyzer so that it shows the greatest number of 0 db LEDs (green on Rane equipment) below the crossover point.
7. Now slowly turn up the Mid frequency output on the crossover until the display shows the same output level average as the Low frequency section.
8. Repeat this procedure for all crossover frequency sections, so that the end result is as flat as possible a response on the analyzer display.

IMPORTANT: Compression driver or horn roll-off, bass roll-off, and room acoustic usually cannot be corrected by the crossover. If, for example, you are adjusting the High frequency control and observe a decline in frequency response somewhat above the crossover point, then set the crossover level control for equal display level near the crossover point and leave it there. Then use an equalizer or bank of tweeters to correct the roll-off problem. If you are tuning the system in a room, the room acoustics will greatly influence the system response, as shown by the analyzer.

Check the system response on an analyzer at several other locations and adjust the crossover as necessary to reach a fixed compromise setting if desired. If you plan to use the analyzer only once to set the crossover, set up the speaker system OUTSIDE or in a very large concert theater, and run pink noise at low levels with closer microphone placement to keep the room acoustics out of the picture as much as possible.

III-4.2. Using an SPL Meter and Pink Noise (Tone Generator).

The mute switches on the AC 22 and AC 23 make using an SPL meter an easy and relatively accurate means of tuning a system. First, obtain a good SPL meter from a local electronics or hi-fi store. Second, and perhaps a little trickier, get a hold of a pink noise generator -- again try electronics and hi-fi stores. You may also use a sweep or tone generator in place of a pink noise

source. If so, be sure to look at several different tones within each crossover section to get a good average of driver response.

1. Run pink noise into the crossover inputs (through the mixer or directly, as is convenient).
2. Make sure all crossover outputs are turned all the way down and all amplifier level controls are at least 1/2 way up to start with.
3. Turn the crossover input(s) half way up. Place the SPL meter at least 15 feet from the speaker stack and about chest high. Once positioned, make sure that the SPL meter remains in the EXACT same location for the rest of the procedure.
4. Slowly turn the Low frequency output of the crossover up until there is a healthy rumble coming from the bass speakers (For this example the 3-way configuration is used -- the same procedure applies to all configurations, starting with the lowest frequency and ending with the highest). Adjust the SPL meter and/or crossover output until you get a 0dB reading on the meter. **AFTER THIS POINT DO NOT CHANGE THE CONTROLS ON THE SPL METER.**
5. While leaving the Low frequency output control at the 0dB adjustment just obtained, press the low frequency Mute switch on the crossover so that the pink noise disappears from the bass speakers (revel in the silence ...).
6. Now slowly turn up the Mid frequency output control so that pink noise is heard from the Mid frequency speakers. Without changing any settings on the SPL meter, adjust the crossover Mid output control until you obtain a 0dB reading on the SPL meter. Now the Low and Mid speakers are set at the same level.
7. Now press the Mid frequency Mute switch on the crossover so that the pink noise again disappears.
8. Repeat this process for each frequency section of the crossover, ending with the highest frequency.*
9. Once the High frequency level is set for 0dB on the meter, disengage all of the mute switches on the crossover, and check that noise is emitting from all the speaker components. The crossover should now be aligned. Make any overall level adjustments with the input level controls and leave the output level controls unchanged.

*NOTE: It is possible that you may turn one of the frequency section output level controls all the way up and still not have enough volume for a 0dB reading (as determined by previous section levels). This is probably due to different sensitivities of amps, speakers and other level controls in the system. When this happens, re-set the SPL meter so that it reads 0dB on this frequency seciton (you may have to "down range" the meter and re-adjust the crossover level control). Now go back and re-adjust the previous crossover level controls, turning these down to get a 0dB reading on the meter.

III-4.3. The Playing It By Ear Method.

With practice a crossover can be tuned fairly well by ear. The following are a few recommendations that might make the job easier, and perhaps more accurate.

1. If at all possible, use **pre-recorded** material as the sound source. The results of your tune-up are likely to be better if:
    a) the material contains a good cross-section of instruments and vocals;
    b) you are familiar with the particular piece and have a good idea what it should sound like.

The advantages of pre-recorded material are that the dynamics are more controlled, even a little compressed which helps, and passages are quickly and consistently repeatable for endless testing. Lastly, you don't have to mess with the mix -- it's fixed for you and one less thing to get in the way.

2. Our ears are designed primarily for the human vocal range. You might then have better results by starting first with the MIDRANGE section and concentrating on the **vocals.** Next bring up the mid-bass slowly (on the crossover) until the vocals are "warmed up" or filled out -- bring the crossover control up and down to get a feel of the most natural setting. Then slowly bring up the mid-hi and/or high frequency controls on the crossover to add presence to the vocals -- again shooting for the most natural or uncolored vocal sound. Now bring up the Low frequency controls to fill out the entire sound to proper balance.

The idea here is to start in the middle frequency area, where the ear is most sensitive, and work outward, always using the midrange as a reference. With practice and concentration this method can be fairly accurate.

3. Whether you use pre-recorded or live material, be sure to set all equalizer controls on the mixer or outboard equalizers to FLAT. Then tune the crossover for the best possible sound. Once this is done you can then go back to each mixer channel EQ or the main house equalizer and fine tune the system.

4. Take advantage of the mute switches on the crossover. By selectively removing sections of the crossover you can compare with and without, to help identify hot or low spots.

IV. FEATURES AND SPECIFICATIONS

4th-Order State Variable Linkwitz-Riley Design:

24dB/octave slopes
Absolutely flat summed amplitude response
Zero phase difference between drivers through crossover regions
All outputs are everywhere in phase
Zero lobing error (no peaking, no axis tilt)

Time Delay Controls for Phase Correction

0-2mS continuously adjustable time delay for each crossover section allow phase alignment electronically between drivers which are not vertically aiigned

Provides means to flatten system response through the crossover regions and maintain zero lobing error

41-Detent Continuous Frequency Selector for Precise Repeatability:

AC 22 Range: 75 - 3.6kHz Low to High
AC 23 Ranges: 70 - 1kHz Low to Mid
450 - 7kHz Mid to High

No hazardous "x 10" switches.

Individual band muting switches for ease of tuning

Built-in subsonic filters, 18dB/octave from 20Hz

Linear phase ultrasonic filters: 6dB/octave in the AC 22, 18dB/octave in the AC 23, from 40kHz

Master system level control with +6dB gain

Level controls on all outputs

On/off transient muting on all outputs

Built-in RFI filters

Auto balanced/unbalanced inputs with 1/4" RTS jacks

Auto floating/unbalanced outputs with 1/4" RTS jacks

Power switch with LED indicator

120/240 VAC 50/60Hz operation

Frequency response: 20Hz - 40kHz +0/−3dB

Total Harmonic Distortion: less than .02%, 20–20kHz, +4dBm

Signal-to-Noise Ratio: 92dB re +4dBm, 20kHz bandwidth

Gain: +12dB

Maximum Input level: +21dBm

Input Impedance: 20k ohms

Maximum Output level: +20dBm into 600 ohms

Output impedance: 100 ohms

Size: 1.75"H x 19"W x 5.25" rack depth, all steel chassis

Weight: 5 lbs. net.